Organic Lemon Production - 2003[1]

Glenn C. Wright and Mohammed Zerkoune
University of Arizona Cooperative Extension

Abstract

An experiment was initiated in 2000 to study the feasibility of growing organic lemons in the southwest desert of Arizona. An eight-acre field was selected on Superstition sandy soil at the Mesa Agricultural Research Center to conduct this investigation. Lemon trees were planted at 25 x 25 feet spacing in 1998. The initial soil test in top 6 inches was 5 ppm nitrate-nitrogen and 4.9 ppm NaHCO3-P. Soil pH was 8.7 in the top 6 inches. Four treatments were applied in randomized complete block design repeated four times. The treatments were beef cattle feedlot manure and perfecta, clover and guano from 2000 to 2002, cowpea and guano in 2003, and guano and perfecta, and standard practice treatment Results from this experiment show that there was no effect of the treatments upon yield for 2001-02 and 2003-04. Fruit size differences for 2002-03 were only evident for medium and small size fruit. Fruit quality, however, did vary by treatment.

Introduction

Total lemon acreage in Arizona is about 13,000 acres down 2,000 acres from 1993 (Arizona Agricultural Statistics 2000. Among the 13,000 acres in the state about 12,000 acres of lemon are grown in Yuma. Yield fluctuates from year to year with an average yield of 550 cartons per acre. There is an increasing demand for organically grown citrus among consumers, and in some markets, there is a premium paid for organic lemons. In Philadelphia for example, fancy grade lemons of size 140 command a $1.00 higher price than non-organic lemons of the same size and grade. Thus, there is also a need for evaluating the possibility of growing lemon organically in Arizona.

Organic amendments are typically used in an organic system. These can include manure, available from two dairy farms in the Yuma region, or bagged or bulk fertilizer, such as guano. Nitrogen can also be added to an organic system through the use of a leguminous, nitrogen-fixing cover crop.

Pest control is one of the most critical challenges facing organically grown citrus. In Arizona, citrus thrips, *Scirtothrips citri* is the primary insect pest that acts as a hindrance to organic citrus production. Traditionally, non-organic broad-spectrum insecticides have been used to control citrus thrips. In 1999 a particle film became available, Surround WP, that was shown to have activity towards citrus thrips. Surround is a highly refined kaolin mineral that produces a white coating on the tree, but does not interfere with photosynthesis or stomatal conductance. This coating acts as a repellent, and clings to thrips that come into contact with it, resulting in some mortality. In addition to thrips control and sunburn protection, Surround has been shown to increase fruit earliness and may increase yield in mature citrus. In 2000, Surround was approved by OMRI as an organic pesticide. Weed control is difficult to achieve in an organic system, however in previous work, we found that a clover cover-crop

[1] The authors wish to thank the Arizona Citrus Research Council for their financial support of this project. This is the final report for project 2003-04 'Organic lemon production'.

would adequately control weeds, while allowing for a higher yield than a weedy orchard floor. Alternatively, the producer can control weeds mechanically, using a disk or the perfecta field cultivator.

The objective of this project is to evaluate the feasibility of growing organic lemons in Yuma.

Materials and Methods

An experimental site was selected on Superstition sand soil at the Yuma Mesa Agricultural Research Center, University of Arizona to evaluate the effect of organic amendments, weed and insect control on lemon growth and yield. Selected soil chemical properties indicated soil pH of 8.7, low nitrate nitrogen level of 2.9 ppm and low potassium level at 59 ppm in the top 6-inches soil. Lemon trees were planted in 1998, twelve trees per row in east west orientation at 25 x 25 feet spacing. Each experimental unit was made of two-twelve tree rows with one-twelve tree row used as a guard row between each treatment unit. All plots were flood irrigated once a week or every other week depending on the season. Beginning in 2000, the experimental layout had four treatments including standard practices, application of manure with weed control using the perfecta cultivator (manure perfecta), clover and application of guano followed by weed control by perfecta (guano perfecta), applied in completely randomized block design replicated four times.
For 2003, manure was applied at 10 tons per acre with a manure spreader in March 2003. Guano was applied three times as guano 7-7-7 N-P-K with irrigation water to provide 40-lb N, 40-lb P and 40-lb K per acre per application. Standard practices treatments included applications of nitrogen and, phosphorus as 11-52-0 (N-P-K). Beginning in 2000, nitrogen in the standard treatments was applied using UN 32-00 as the source at a rate of 250 lbs. per acre.

In 2003 cowpea replaced clover as an alterative cover crop, was planted in late January, 2003. We anticipated that the cowpea would out compete and control weeds in the cowpea treatment better than clover did in previous years. Weeds in the standard treatment were controlled by a repeated disking and roundup application. In the manure and guano treatments we used a Perfecta field cultivator to control weeds.

Thirty leaves were randomly collected in zip lock bags in June and August, 2003 and brought to the laboratory. Leaves were washed with distilled water, then were dried at 60C and ground to pass 1 mm sieve before they were sent to a commercial laboratory.

For 2001 and 2002, insect control treatments were divided into two regimes, organic and a commercial standard. Details of these treatments and the insect population monitoring are found in previous reports for this project. For 2003, applications of Surround WP (kaolin) applied at 50 lbs/ac, in 250 gallons of water per acre.

Yield data is collected during the fall and winter. For 2001-02, yield data was collected on 2/7/02, and the average weight per tree was less than 1.0 lb per tree, thus that data is not presented here. For 2002-03, the entire yield of the treated row was harvested in 11/02 and was passed through an automated electronic eye sorter (Autoline, Inc., Reedley, CA), which provides weight, color, exterior quality and size data for each fruit. Fruit packout data is reported on a percentage basis. Fruit quality data was collected at each harvest time. These data are presented for the first time in this report. For 2003, the fruit was harvested on 10/17/03. Technical difficulties precluded collection of quality and size data for 2003.

Results

Leaf nutrient content is shown in Figure 1. Nitrogen levels of the four treatments were generally deficient, while leaf phosphorous and potassium levels were sufficient or above the sufficiency range. Iron levels in the treated trees were generally well within the sufficient range, except for the manure perfecta treatment, perhaps indicating that much of the iron that would normally be available to these trees could instead be found on the cation exchange sites of the manure. Manganese and zinc levels of all four treatments were low.

Yield, packout and quality

Lemon yield data collected in 2001-2003 are reported in Figure 2. For 2001-02 and 2003-04, there was no effect of treatment upon yield. However, in 2002-03, trees in the manure/perfecta treatment and the clover/cowpea treatment had significantly greater yields than the other two treatments.

Fruit size for 2002-03 is shown in figure 3. There was no effect of treatment upon the three largest fruit size, however, the guano perfecta and the clover/cowpea treatment had significantly more size 140 fruit, while the manure perfecta treatment had significantly less size 200 fruit than did the other treatments.

Standard control and manure perfecta treatments had significantly more fancy grade fruit than did the guano perfecta, while the clover/cowpea treatment was intermediate. Conversely, the guano perfecta treatment led to more choice grade fruit than the other treatments. There was no effect of treatments upon juice grade fruit.

Since fruit yield, packout and grade were similar for all the treatments, we suggest that it is possible to grow a commercially acceptable lemon using organic practices.

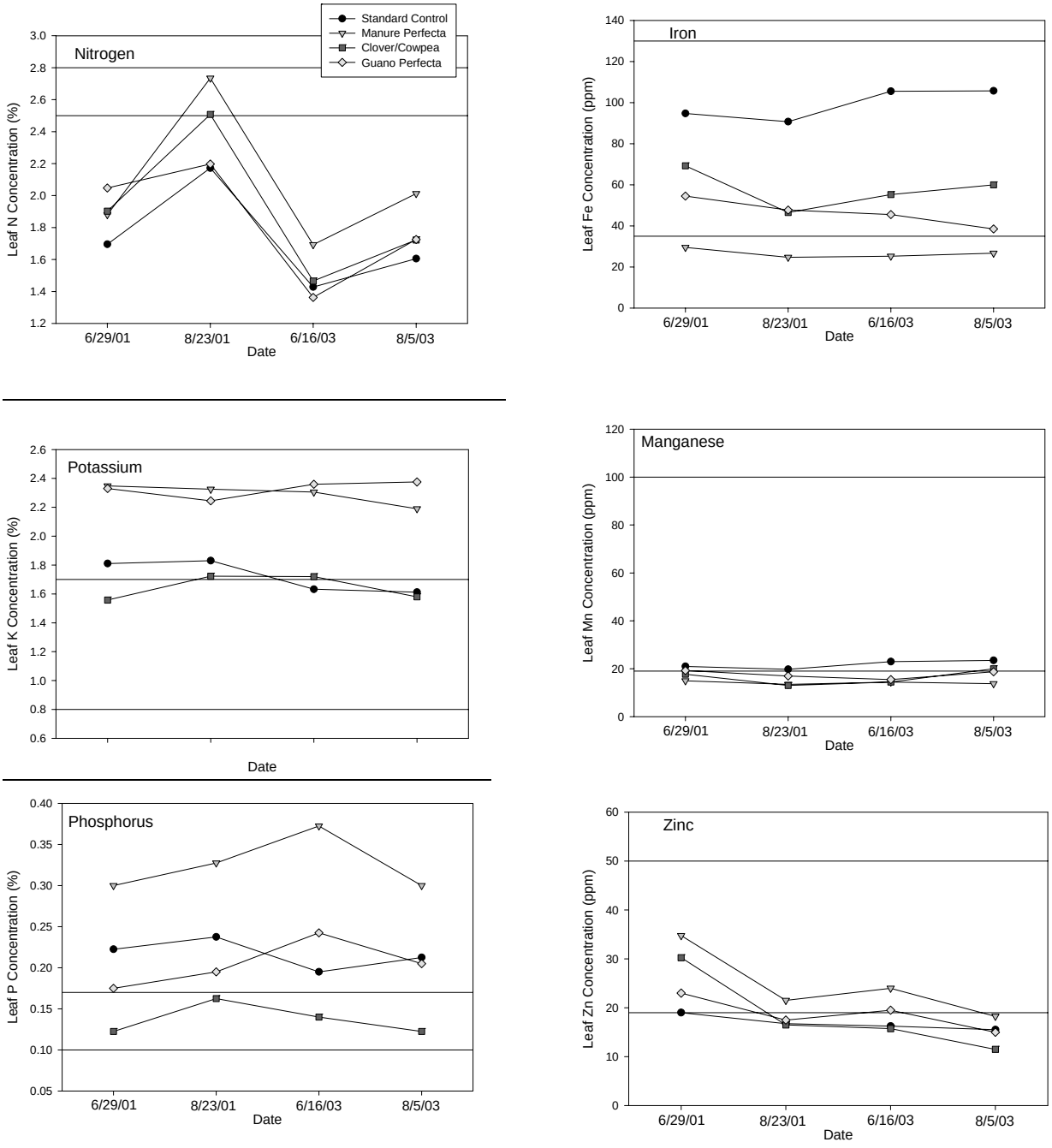

Figure 1. Leaf nutrient concentration of organic and conventional grown citrus trees. Horizontal reference lines on the respective graphs indicate deficient and excess levels of the nutrient in question.

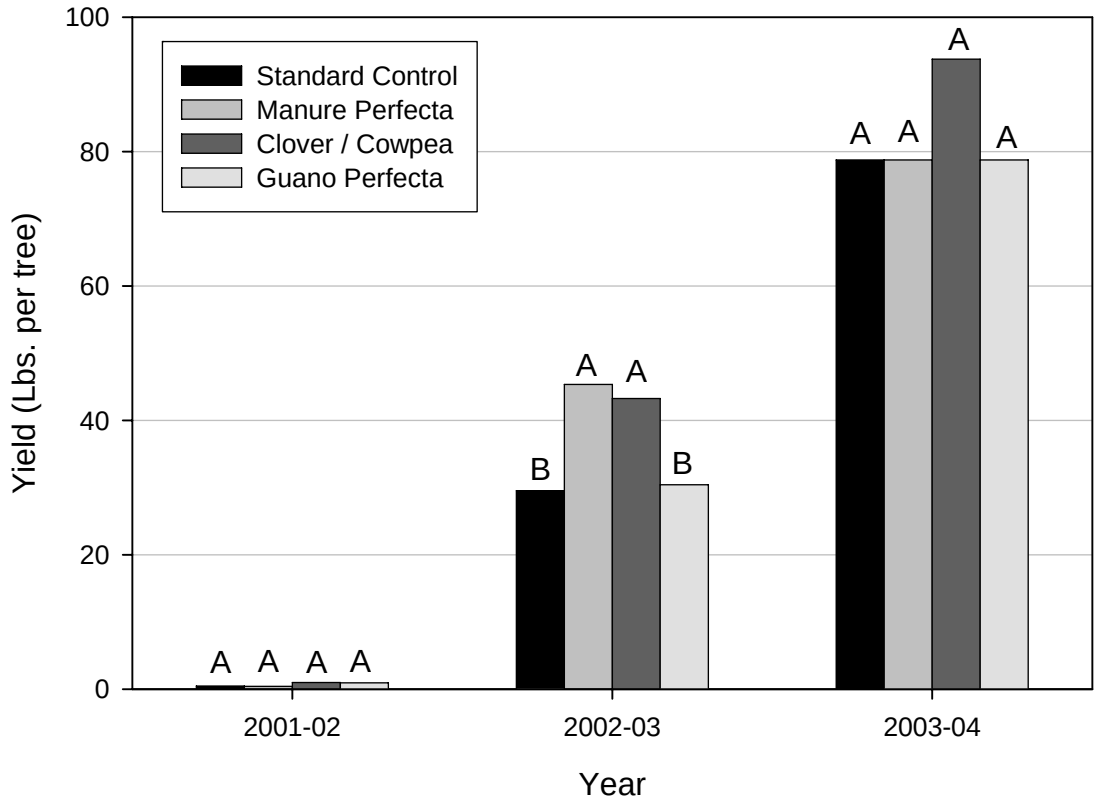

Figure 2. Lemon yield as affected by organic amendments and standard fertilizer practices at Yuma Mesa Research Station, Yuma 2001-2004. Bars within the same group with the same letter designation are not significantly different.

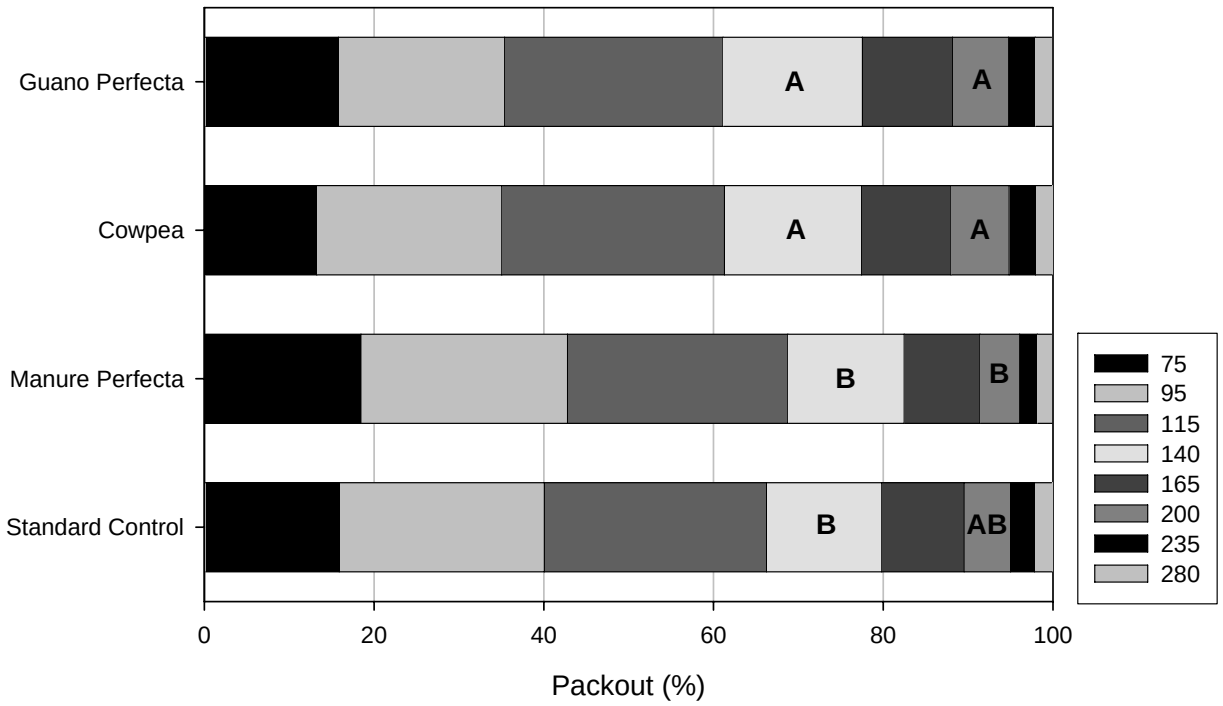

Figure 3. Lemon packout as affected by organic amendments and standard fertilizer practices at Yuma Mesa Research Station, Yuma 2002-03. Bars of the same color with different letter designation are significantly different. Bars with no letter designations are not significantly different.

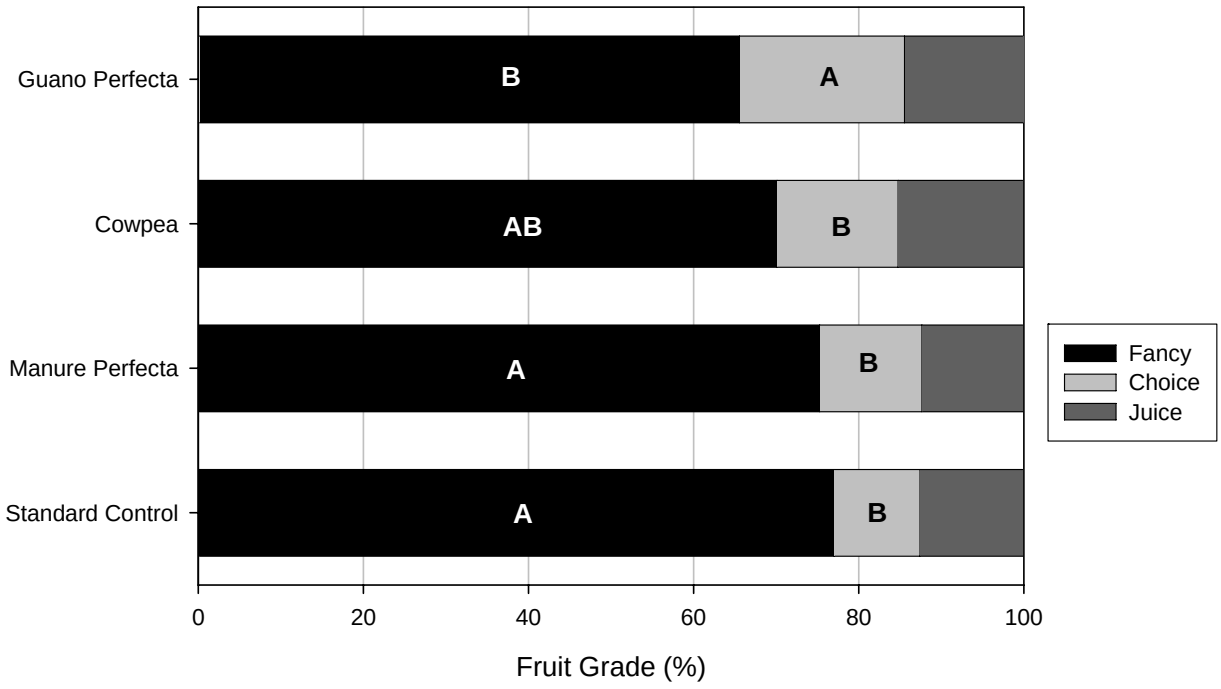

Figure 4. Lemon grade as affected by organic amendments and standard fertilizer practices at Yuma Mesa Research Station, Yuma 2002-03. Bars of the same color with different letter designation are significantly different. Bars with no letter designations are not significantly different.